United States
Department of
Agriculture

Forest Service

Forest Pest
Management

Davis, CA

Spread Factor Regression
SPREAD
Version 2.0

User Manual
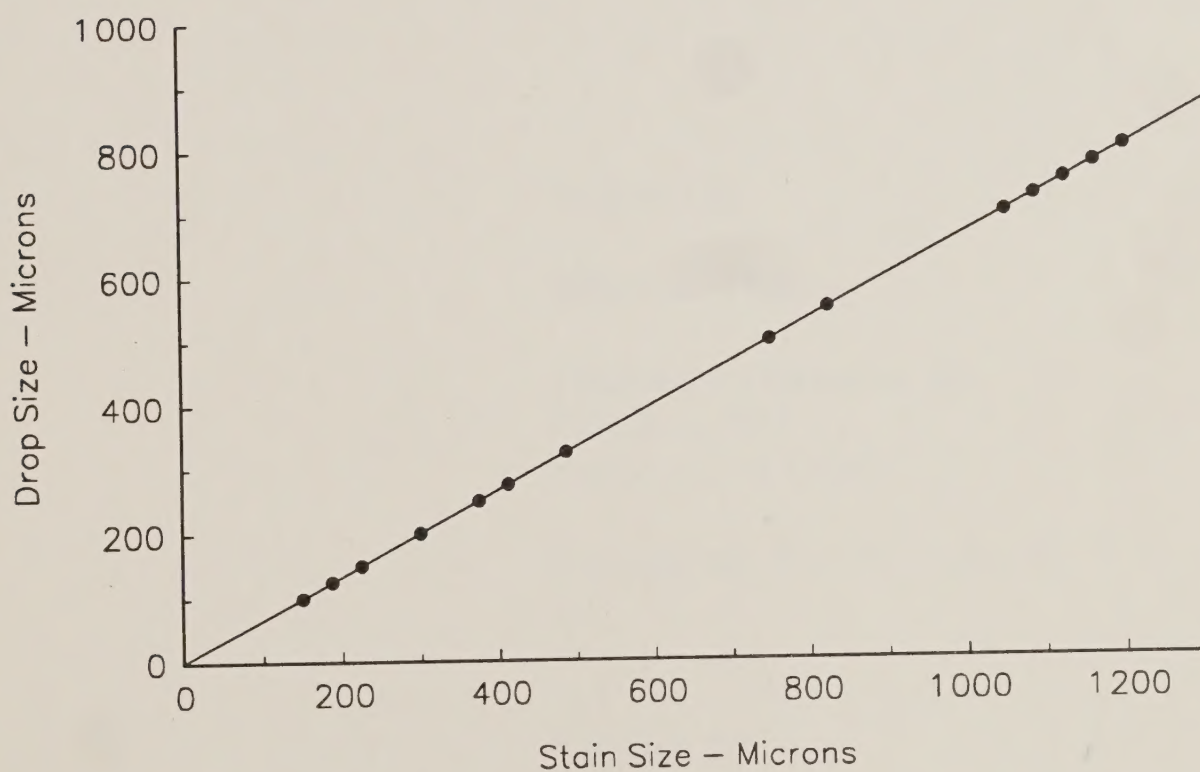
$$D = a + b*S + c*S^2$$

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Prepared by:

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INTRODUCTION

The Spread Factor Regression program SPREAD 2.0 correlates data collected from the concurrently applied techniques of Kromekote stain cards and Magnesium Oxide slides. These reduced data are entered into SPREAD and a curve fit is invoked to relate stain size to actual drop size. This curve fit may then be applied to field witness cards to recover the drop size distribution of material landing on the cards.

This version of the program is an extension of an earlier mainframe computer program developed by R. Thompson (private communication).

This user manual moves through the various menus and output options available in version 2.0 of SPREAD. The accompanying 3-1/2 inch diskette contains the program for operation on a personal computer.

INTRODUCTION

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This version of the program is an extension of an earlier mainframe computer program developed by R. Thompson (private communication).

This user manual moves through the various rooms and output options available in version 2.0 of SPREAD. The accompanying 5-1/2 inch diskette contains the program for operation on a personal computer.

SPREAD OPERATION

SPREAD is initiated with the command

SPREAD < cr >

followed by a carriage return < cr > or enter keystroke. The program must be in the current subdirectory, or accessed through the DOS PATH statement. SPREAD may also be invoked with a filename on the command line

SPREAD familyname < cr >

where familyname is the Family name of the data to be examined (a file to be created in the present run, or saved from a previous run).

SPREAD is configured for operation on CRT color monitors; thus, LCD gray-scale monitors may fail to represent some menus adequately. To overcome this effect the user may initiate SPREAD in a black-and-white mode by including a separate character string ("/g") on the command line to indicate operation on a gray-scale monitor:

SPREAD /g < cr >

SPREAD familyname /g < cr >

All operations will then commence in black and white only.

SPREAD appends the following extensions to the familyname:

DAT   Data entry file

EXP   Exportable drop size file

PRT   Output printer listing file

Only screen dumps of plotted images may be performed inside SPREAD; hence, the DOS GRAPHICS command must be invoked prior to running SPREAD, or higher-level copy techniques (such as PIZZAZ PLUS) must be in place. Movement around SPREAD menus is made by the cursor arrow keys; a carriage return, or enter, selects an option; data entry is completed with a carriage return or enter; and the escape key

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SPREAD is initiated with the command

    SPREAD ... <cr>

allowed by a carriage return < cr > or enter. The ... must be in the current subdirectory, or accessed through the PATH statement. SPREAD may also be invoked with a filename ... on the line ...

    SPREAD familyname : <cr>

where familyname is the "family name" of the data to be examined. It ... be created in the present run, or saved from a previous run.

SPREAD is configured for operation on CRT color monitors. Thus, LCD gray-scale monitors may fail to represent some ... Instead ... to overcome this effect the user may initiate SPREAD in a black-and-white mode by including a separate character string ("/g") on the command line to indicate operation on a gray-scale monitor.

    SPREAD -/g

    SPREAD familyname /g < cr>

All operations will then commence in black and white only.

SPREAD appends the following extensions to the familyname:

    DAT   Data entry file

    EXP   Exportable drop size file

    G..   printer listing file

... of plotted images may be performed inside ...; hence the ... 3RAPHICS command must be invoked prior to SPREAD or higher-level ... techniques (such as PIZZAZ) ... in place. Movement around SPREAD menus is made by ... key ... carriage return, or enter, selects an option; data ... a carriage return or enter; and the escape key

< esc > exits a menu (program operations may be performed upon menu exit).

The main menu gives:

Information
File and Screen
Description
Kromekote Data
Magnesium Data
Curve Fits
Graphics
EXIT

Information

Information provides an overview of SPREAD operation, and its historical references.

File and Screen

File and Screen leads to the menu:

FAMILY Name
Screen Type

which will be entered automatically if a Family name is present on the command line. **SPREAD will NOT operate without a Family name!** Screen Type offers CGA, EGA and VGA.

Upon < esc > from this menu, SPREAD will attempt to read the entered file. The program status messages that could occur include:

No FAMILY Name Entered   SPREAD must be given a Family name to read or save input data

Reading familyname.DAT   SPREAD is recovering previously saved data in a Family name

Creating familyname.DAT	SPREAD intends to create a new Family name on EXIT from the program (at user discretion)
Invalid FAMILY Name	The given Family name is not DOS correct

Description

Description leads to a screen editor that permits the user to move around the entered description information with the cursor arrow keys, delete, carriage return or enter, or adding valid characters. The description may consist of up to ten lines of information.

Kromekote Data

Kromekote Data leads to a screen editor that permits the user to move around the entered Kromekote stain data with the cursor arrow keys, delete, carriage return or enter, or adding valid characters (numbers). Each line must contain two numbers; the first is an identified stain size (in microns), and the second, the number of occurrences of this stain size. Separation of these two columns of information is by blank spaces. Up to 100 entries of Kromekote stain data may be made into SPREAD. The stain size data does not have to be in any particular order since the program sorts the data from smallest stain size to largest stain size during calculations.

Magnesium Data

Magnesium Data leads to a screen editor that permits the user to move around the entered Magnesium Oxide slide data with the cursor arrow keys, delete, carriage return or enter, or adding valid characters (numbers). Each line must contain two numbers; the first is an identified drop size (in microns), and the second, the number of occurrences of this drop size. Separation of these two columns of information is by blank spaces. Up to 100 entries of Magnesium Oxide slide data may be made into SPREAD. The drop size data does not have to be in any particular order

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since the program sorts the data from smallest drop size to largest drop size during calculations.

Curve Fits

Curve Fits analyzes all of the entered data, first the **Kromekote Stain Data**; then the **Magnesium Oxide Data**; and finally performing the **Regression Analysis**. The program status messages that could occur include:

Incomplete Kromekote Data

The number of entered lines of Kromekote stain data does not match with the acceptable data values; or fewer than four acceptable data values were entered

Incomplete Magnesium Data

The number of entered lines of Magnesium Oxide slide data does not match with the acceptable data values; or fewer than four acceptable data values were entered

Incomplete Regression Data

Fewer than four acceptable data values were entered for either stain or slide data

If successful to this point, SPREAD will proceed to compute the following regressions:

Kromekote stain data versus its cumulative frequency (number of stains below this stain size divided by the total number of stains) -- this curve fit is accomplished within the program by taking the logarithm of the stain data to recover a variation that is nearly linear (Teske, Skyler and Barry 1991).

Magnesium Oxide drop data versus its cumulative frequency (number of drops below this drop size divided by the total number of drops) -- this curve fit is accomplished within the program by taking the logarithm of the drop data.

Three curve fits of Kromekote stain sizes versus Magnesium Oxide drop sizes for the three formulae types in ASCAS (Teske 1991):

$$(\text{Drop Diameter}) = A + B * (\text{Stain Diameter}) + C * (\text{Stain Diameter})^2$$

$$(\text{Stain Diameter}) = A + B * (\text{Drop Diameter}) + C * (\text{Drop Diameter})^2$$

$$(\text{Drop Diameter}) = A * (\text{Stain Diameter})^B$$

The resulting regression coefficients A, B and C, along with their corresponding Regression Correlation R^2, are then presented in a screen table. A Regression Correlation of 1.0 implies a perfect curve fit of the data. Conversion of the Magnesium Oxide data requires the use of a calibration factor of 0.857 on drop sizes read from slides (May 1950).

Graphics

Graphics permits the presentation of results onto the personal computer screen. The variables that may be plotted include:

Stain Diameter vs. Cumulative Frequency
Drop Diameter vs. Cumulative Frequency
Drop Diameter as a quadratic function of Stain Diameter
Stain Diameter as a quadratic function of Drop Diameter
Drop Diameter as a power law function of Stain Diameter

In each case the plot may be centered on the screen (the only plot) or placed in one of the four corners (upper left, upper right, lower left, lower right).

EXIT

EXIT permits exiting from SPREAD. EXIT may also be achieved by < esc > at the main menu. The presented options include:

... of Regression equations ... Manual ... for the ... used for ... formulae types in ... (C.A. Troske 199...

$$(Drop\ Diameter) = A + B * (Stain\ Diameter) + C * (...)$$

$$(Stain\ Diameter) = ... + ... * (Drop\ Diameter) + C * (1...Diam...$$

$$(Drop\ Diameter) = A * (Stain ... linear ...$$

The resulting regression coefficients ... B and C ... along with ... corresponding Regression Correlation ... are ... presented in a ... screen ... A Regression Correlation of 1.0 imp... perfect ... ... data. Conversion of the Magnitude ... Da... as required. The ... calibration factor of 0.857 ... drop sizes read from ... may ...

Graphics

Graphics permits the presentation of results ... ... the present computer screen. The variables that may be plotted include:

Stain Diameter vs. Cumulative Frequency
Drop Diameter vs. Cumulative Frequency
Drop Diameter as a quadratic function of Stain Diameter
Stain Diameter as a quadratic function of Drop Diameter
Drop Diameter as a power law function of Stain Diameter

In each case the plot may be centered on the screen (the only plot) or placed in one of the four quadrants (upper left, upper right, lower left, lower right).

From SEWBASD, EXIT may also be achieved. The presented options include:

Print Results
Export Results
Save Data
Return to SPREAD
EXIT SPREAD

Print Results generates the file familyname.PRT with sections for:

Data Description
Kromekote Stain Data
Magnesium Oxide Data
Stain Factors

Export Results generates the file familyname.EXP and stores column data (separated by a comma) of Stain Diameter (in microns) and Drop Diameters (in microns) for the three curve fit techniques: Drop Diameter as a quadratic function of Stain Diameter; Stain Diameter as a quadratic function of Drop Diameter; and Drop Diameter as a power law function of Stain Diameter. This file may then be read by other graphics/statistical packages such as Lotus 1-2-3 or Harvard Graphics.

Save Data writes all input data into familyname.DAT.

Return to SPREAD permits the user to return to the program. This is especially useful if the user wishes to save data periodically as it is being entered, and in case < esc > was mistakenly pushed.

EXIT SPREAD really exits the program. **Input data will NOT be saved even if the user has changed it**, unless Save Data has been invoked before exiting SPREAD.

EXAMPLE

One example is included on the program diskette.

TEST.DAT is a typical input file, and gives the following results:

Curve Fit Type	a	b	c	r^2
1	39.549	0.54045	-0.000011899	0.9510
2	-72.887	1.8426	0.000080610	0.9510
3	1.5907	0.84787		0.9508

REFERENCES

May, K.R. 1950. The measurement of airborne droplets by the magnesium oxide method. *Journal of Scientific Instrumentation* 27: 128-130.

Teske, M.E. 1991. ASCAS version 4.0 user documentation. FPM 92-3 (C.D.I. Technical Note No. 91-14). Prepared under contract 53-0343-1-00153 by Continuum Dynamics, Inc. for USDA Forest Service, Forest Pest Management, Davis, CA.

Teske, M.E., P.J. Skyler and J.W. Barry. 1991. A drop size distribution data base for forest and agricultural spraying: potential for extended application. NIST Special Publication 813. Presented at the *5th international conference on liquid atomization and spray systems, ICLASS-91*. Gaithersburg, MD.